

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of
Jonsson et al.

Serial No.: 10/799,322

Filed: March 12, 2004

For: **Method and Apparatus for Received
Signal Quality Estimation**

Attorney's Docket No: 4015-5191

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) Examiner: Mr. Leon Flores
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Dear Sir or Madam:

This appeal brief is timely filed within one month of the Office's 26 February 2009 mailing of the Notice of Panel Decision from Pre-Appeal Brief review. Thus, no extension-of-time fees should be required for its entry. Appellant submits herewith payment in the amount of \$540 to cover the appeal brief fee. If any further fees or charges are required, the Commissioner is hereby authorized to charge them to Deposit Account 18-1167.

APPEAL BRIEF

(I.) REAL PARTY IN INTEREST

The real party in interest is Telefonaktiebolaget LM Ericsson (publ).

(II.) RELATED APPEALS AND INTERFERENCES

To the best of Appellant's knowledge, there are no related appeals or interferences.

(III.) STATUS OF CLAIMS

Claims 1-47 are pending. Claims 1-9, 11-24, and 26-47 stand rejected by the examiner. Claims 10, 25, and 39 are objected to as allowable but for dependency on a rejected base claim. Appellant appeals the rejection of claims 1-9, 11-24, and 26-47.

(IV.) STATUS OF AMENDMENTS

No amendments have been submitted subsequent to the Final Office Action dated September 17, 2008.

(V.) SUMMARY OF CLAIMED SUBJECT MATTER

The pending claims under appeal include claims 1-9, 11-24, and 26-47, which include independent claims 1, 17, 31, and 45. No claim under appeal is in means-plus-function or step-plus-function form pursuant to 35 U.S.C. §112, ¶ 6. Thus, only the independent claims under appeal are summarized below, in accordance with 37 C.F.R. § 41.37(v) and (vii).

A. Independent claim 1

Independent method claim 1 is directed to a method of determining received signal quality for a received signal in an inter-symbol interference canceling receiver. See claim 1, preamble. As explained in the Specification, at paragraphs 15 and 16 (p. 7, lines 3-24), it is often necessary for a wireless mobile terminal to determine received signal quality in order to properly generate power control commands for transmission to a serving radio base station (RBS) or to provide channel quality indicators (CQIs) to the radio base station for use in determining appropriate scheduling of radio link resources. However, in complex receivers configured to cancel inter-symbol interference (interference caused by the reception of multiple versions of the transmitted signal arriving via different paths, thus causing “smearing” of the received data symbols), accounting for un-cancelled inter-symbol interference in signal quality calculations can be quite complex. The claimed method is thus directed to a technique that accounts for the inter-symbol interference performance of the receiver by using a simple scalar value that represents the performance of the receiver to scale an estimate of the inter-symbol interference present in the received signal, and estimating the received signal quality based on that scaled estimate. See Specification, ¶¶ [0007]-[0008] (p. 3, line 22 – p. 4, line 17).

In particular, the method of claim 1 comprises (1) generating an estimate of inter-symbol interference in the received signal, (2) scaling the estimated inter-symbol interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the

receiver, and (3) estimating the received signal quality based on the scaled estimate of inter-symbol interference.

Figure 2 is a process flow diagram illustrating exemplary processing logic that may be carried out by a receiver processing circuit according to some embodiments; the features of Figure 2 correspond directly to the features of claim 1. As the specification explains, the illustrated processing assumes that samples of the received signal of interest are available for evaluation, and the signal quality estimation processing thus begins with an evaluation of those samples to generate an estimate of inter-symbol interference (ISI) in the received signal, as shown at block 100 of Figure 2.

Specification at ¶ [0029] (p. 11, lines 19-23). Particular details of techniques for estimating the ISI are provided in the Specification at paragraphs [0039] to [0042] (p. 14, line 12 – p. 15, line 20).

The claimed method further includes the scaling of the estimated ISI by an appropriately valued cancellation metric that is tied to the ISI cancellation performance of the receiver, as shown at block 102 of Figure 2. *Id.* at ¶ [0030] (p. 11, lines 24-26). In particular, and as claimed in claim 1, this cancellation metric is a simple scalar value that reflects the cancellation performance expected of the interference-cancelling receiver. *Id.* at ¶ [0031] (p. 12, lines 4-5). As the specification explains, this cancellation metric can be a pre-configured value related to pre-characterized cancellation performance of the receiver, or it can be a value that is calculated during ongoing operations of the receiver, i.e., by measuring the cancellation performance of the receiver during live operation. *Id.* ¶ [0030] (p. 11, line 26 – p. 12, line 3).

Finally, the claimed method includes the estimation of received signal quality for the received signal based on the scaled estimate of inter-symbol interference, as shown at block 104 of Figure 2. This approach allows the receiver to anticipate the cancellation performance from the receiver's combining of the received signal, but without requiring the actual computing of the combining weights that may ultimately be used to effect such combining. *Id.* at ¶ [0031]-[0032] (p. 12, lines 4-22). Details of a particular calculation of the signal quality for the received signal, based on a scalar cancellation metric denoted u , are provided in the Specification at paragraphs [0039] to [0042] (p. 14, line 12 – p. 15, line 20).

B. Independent claim 17

Independent claim 17 is directed to a processing circuit configured for use in an inter-symbol interference canceling receiver. The processing circuit includes an interference estimation circuit, a scaling circuit, and a signal quality estimation circuit that are respectively configured to carry out the generating, scaling, and estimating features of method claim 1. An embodiment of the claimed processing circuit, labeled reference number 36, is illustrated in Figure 4, and is described in the Specification at paragraphs [0034] to [0038] (p. 13, line 4 – p. 14, line 11). In particular, paragraph [0034] notes that the processing circuit 36 may be configured according to the exemplary processing of Figure 2, which is summarized above with respect to claim 1.

C. Independent claim 31

Independent claim 31 is directed to a wireless communication device for use in a wireless communication network. The claimed device includes a receiver configured to receive signals from the network, a transmitter configured to transmit signals to the network, one or more control circuits configured to control operation of the receiver and transmitter, and is described in detail at paragraphs [0033] to [0036] of the Specification (p. 12, line 23 – p. 13, line 24.) Of particular relevance to this appeal, the claimed receiver comprises one or more processing circuits that include an interference estimation circuit, scaling circuit, and signal quality estimation circuit corresponding directly to the circuits of independent claim 17. As with the circuits of claim 17, these circuits are configured to carry out the respective generating, scaling, and estimating features of method claim 1.

D. Independent claim 45

Independent claim 45 is directed to a computer readable medium storing a computer program to determine received signal quality for a received signal in an inter-symbol interference cancelling receiver. In particular, the stored computer program comprises program instructions to carry out each of the generating, scaling, and estimating features of claim 1. Thus, the description summarized above of the processing illustrated in Figure 2 is directly applicable to claim 45.

(VI.) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The examiner rejects claims 1-9, 11-24, 26-38, and 40-47 under 35 U.S.C. § 103(a) as unpatentable over Bottomley *et al.*, “A Generalized RAKE Receiver for Interference Suppression”, IEEE Journal on selected areas in communications, vol. 18, no. 8, pp. 1536-45, Aug. 2000 (hereinafter “Bottomley”) in view of U.S. Patent Application Pub. No. 2003/0053526 A1, to Reznik (hereinafter “Reznik”).

(VII.) ARGUMENT

The examiner bears the initial burden of presenting a prima facie case of obviousness. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). If that burden is met, then the burden shifts to the Appellant to overcome the prima facie case with argument and/or evidence. *See Id.* The analysis need not seek out precise teachings directed to the specific subject matter of the claim but can take into account the inferences and the creative steps that a person of ordinary skill in the art would employ. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007). However, an obviousness rejection cannot be sustained by mere conclusory statements; there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *Id.*, quoting *In re Kahn*, 441 F. 3d 977, 988 (Fed. Cir. 2006). As shown below in detail, the examiner here fails to meet his burden of presenting a prima facie case of obviousness.

A. The cited combination of references fails to disclose the features of independent claims 1, 17, 31, and 45.

Claim 1 is a method claim directed generally to a method of determining received signal quality in an inter-symbol interference canceling receiver. Independent claims 17 and 31 are closely corresponding apparatus claims directed to a processing circuit and wireless receiver, respectively, each configured to carry out the method of claim 1. Independent claim 45 is directed to a computer-readable medium storing a computer program comprising program instructions to carry out the method of claim 1. Claim 1 is thus representative of the features of all the pending independent claims, and reads:

1. A method of determining received signal quality for a received signal in an inter-symbol interference canceling receiver comprising:

generating an estimate of inter-symbol interference in the received signal;

scaling the estimated inter-symbol interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver; and

estimating the received signal quality based on the scaled estimate of inter-symbol interference.

The examiner's rejections fail to properly establish a prima facie case of obviousness. In particular, the examiner makes specific factual findings including: (1) that Bottomley teaches scaling estimated inter-symbol interference by a cancellation metric, albeit not the cancellation metric of the present claims; (2) that Reznik teaches, or at least "suggests," scaling estimated inter-symbol interference by a cancellation

metric meeting the limitations of the present claims; (3) that although estimating received signal quality based on the scaled estimate of inter-symbol interference is taught by neither reference, Reznik “suggests” such an estimation; and (4) that, in any event, one skilled in the art “would know” that Reznik’s “soft decisions” or “hard decisions” may be used to compute the signal quality. All of these factual findings are incorrect, and unsupported by the cited references.

Indeed, as demonstrated below, the examiner’s rejections are based on a finding that a disclosed matrix is somehow equivalent to a scalar value, on a finding that two references that are utterly silent with respect to either characterizing or measuring cancellation performance of a receiver somehow disclose such a characterization or measurement when combined, and on a finding that a reference that provides no mention whatsoever of received signal quality nevertheless “suggests” estimating received signal quality based on a scaled estimate of inter-symbol interference. These findings of fact are without merit, and all of the pending rejections are thus improper for at least these reasons.

1. Neither reference discloses the claimed “cancellation metric”.

Claim 1 recites, in part, “scaling the estimated inter-symbol interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver.” Claims 17 and 31 include corresponding limitations. In fact, neither reference discloses or suggests such a cancellation metric.

The examiner admits that Bottomley fails to teach scaling the estimated interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver. Final Office Action at p. 5. However, the examiner then asserts that “Reznik does,” citing Reznik’s Equation 10, claim 10, Figures 8 and 9, and paragraphs 40, 50, and 67, and particularly referring to Reznik’s “matrix S.” *Id.* at pp. 5-6. The examiner’s comments on pages 3-4 of the Final Office Action and on page 2 of the Advisory Action confirm that the examiner is equating Reznik’s matrix S with the claimed cancellation matrix. In fact, Reznik’s matrix S is not a scalar value at all. Furthermore, Reznik’s matrix S does not represent characterized or measured inter-symbol interference performance of the receiver.

a. Reznik’s matrix S is not “a scalar value.” Reznik’s equation (10) does not disclose (or suggest) scaling an estimate of inter-symbol interference by a scalar value at all. Instead, Reznik’s Equation 10, which reads “ $\vec{d}(m) = S(\vec{y} - \vec{c}(m))$ ”, teaches that a residual interference vector $\vec{c}(m)$, output by a feedback interference processor, is iteratively subtracted from the received signal, with the difference multiplied by a matrix S. Reznik, ¶¶ [0074]-[0075]. None of the components of Reznik’s Equation 10 is a scalar value; each of the terms is either a vector or a matrix. *Id.* In particular, Reznik’s matrix S, the focus of the examiner’s rejections and arguments, is clearly not a scalar value.

The examiner argues that “one skilled in the art would know that Matrix O is composed of scalar values ... [a]nd matrix S is calculated based on matrix O.” Final Office Action at p. 3. Appellant does not dispute that Reznik’s matrices O and S are

formed from scalar values. But it clearly does not follow that matrix S is a scalar value, which term would be understood by a person of ordinary skill in the art to refer to a single real number, rather than a vector or matrix. The examiner's argument on this point is completely spurious.

b. Reznik's matrix S does not represent "characterized or measured inter-symbol performance of the receiver." There is no teaching or suggestion in Reznik with regards to a cancellation metric that represents the characterized or measured inter-symbol interference cancellation performance of the receiver. In fact, Reznik is utterly silent with respect to inter-symbol interference cancellation performance of a receiver, and does not provide any hint that the receiver's performance should be measured, characterized, or otherwise quantified. Although the examiner offers Reznik's matrix S for the claimed cancellation metric, Reznik actually teaches that S is calculated directly from estimates of the system channel impulse response, completely without regard to the interference-cancellation performance of a particular receiver. See Reznik, ¶¶ [0091]-[0092]. Reznik does not otherwise suggest that the matrix S is somehow representative of the measured or characterized cancellation performance of a receiver.

In the Advisory Action of November 25, 2008, the examiner elaborated on his contention that Reznik teaches the claimed scalar value representing receiver cancellation performance. The examiner's arguments therein purport to show, inter alia, that: (1) the inter-symbol cancellation performance of Reznik's receiver depends on Matrix A ; (2) Matrix A is used to compute Matrix S ; and (3) Reznik suggests using "such a scalar value" to scale an estimate of inter-symbol interference in a received signal. In the Final Office Action, the examiner raises related arguments:

ISI cancellation performance in the receiver is dependent on Matrix S, which further depends on Matrix A. (See fig. 9) And Matrix A is computed based on channel estimates calculated at the receiver, and it contains information about intersymbol interference present in the received data signal. (See fig. 8 & ¶ 67) Furthermore, Reznik does teach that the system architecture [sic] delegates the cancellation of ISI to the direct interference canceller.

Final Office Action at pp. 3-4.

These arguments miss the mark. Whether or not the examiner's three premises in the Advisory Action are correct (at least the third, in fact, is not), the claims specifically recite a scalar value that "represent[s] characterized or measured intersymbol interference cancellation performance of the receiver." The examiner's arguments suggest that since ISI cancellation in Reznik's receiver depends on matrix S, then matrix S "represents" the performance of the receiver. This logic utterly fails, given any reasonable understanding of the claimed cancellation metric. The Final Office Action appears to be saying simply that matrix S determines, or has an effect on, the cancellation performance of the receiver. This is true, so far as it goes – as the examiner notes, matrix S is derived from Reznik's matrix A, which includes information about interference present in the received signal, and successful cancellation of interference depends at least in part on an accurate characterization of the received signal. However, a matrix that incorporates information about the received signal's instantaneous characteristics is effectively the opposite of what the present claims recite: a value that represents characterized or measured ISI cancellation performance

of the *receiver*, i.e., a metric that quantifies how well the cancellation process is expected to perform. Reznik does not in fact disclose or suggest the measuring or characterizing of receiver performance, and does not disclose or suggest a metric that represents a measured or characterized receiver performance.

2. Neither Reznik nor Bottomley discloses “scaling the estimated inter-symbol interference by a cancellation metric” of any sort.

Claim 1 recites, in part, “scaling the estimated inter-symbol interference by a cancellation metric”. Independent claims 17, 31, and 45 include similar limitations. As shown above, neither of the cited references discloses or suggests the particular cancellation metric claimed. Furthermore, neither reference discloses or suggests scaling estimated inter-symbol interference by a cancellation metric of any sort.

a. Reznik’s matrix S is not used to scale an estimate of inter-symbol interference. The examiner repeatedly cites Reznik’s Equation (10) as the basis for concluding that “Reznik suggests scaling the estimated inter-symbol interference by a cancellation metric.” See, e.g., Final Office Action at pp. 3-6; Advisory Action at p. 2. However, Reznik’s equation (10) shows only that a residual interference vector $\vec{c}(m)$ is subtracted from a received signal vector \vec{y} , and that the resulting difference vector is multiplied by a matrix S. Reznik, ¶ [0075]. Reznik’s matrix S is not used to scale an estimate of inter-symbol interference in the received signal. The vector \vec{y} is a filtered version of the received symbol, and the vector $\vec{c}(m)$ corresponds to the residual interference that remains after ISI has been canceled. *Id.* at Figure 9, ¶¶ [0073]-[0076].

Although Reznik refers to the vector $\vec{c}(m)$ as “interference estimates”, the

complete reference is to “us[ing] the direct interference canceller output estimates d to arrive at interference estimates output as a vector c *that were not previously canceled* by the direct interference canceller.” *Id.* at ¶ [0074], emphasis added. Thus, none of the elements of Equation (10) is the claimed “estimate of inter-symbol interference in the received signal.”

b. Bottomley does not suggest scaling an estimate of inter-symbol interference.

The examiner asserts that Bottomley teaches scaling estimated inter-symbol interference by a cancellation metric, while admitting that Bottomley fails to disclose the cancellation metric of the claims. Final Office Action at p. 5. However, Bottomley does not in fact teach the scaling of estimated inter-symbol interference by any metric at all. Thus, the examiner’s proposed incorporation of Reznik’s matrix S into “the system of Bottomley” falls apart, and the examiner’s rejection fails to establish a *prima facie* case of obviousness.

To support the finding that Bottomley teaches the scaling of estimated inter-symbol interference, the Final Office Action cites Bottomley’s equations (7), (9), and (41), as well as the text introducing equation (42). Final Office Action at p. 5. Bottomley’s equation (7) illustrates the computation of a decision statistic in a RAKE receiver based on a multiplication of a combining weights vector w by a received signal vector y . Bottomley at p. 1538. Equation (9) illustrates that the combining weights vector w may be computed through vector multiplication of the inverse of a covariance matrix R_u (representing a model of total noise and interference) by a vector h (representing a propagation channel response). *Id.* These first two equations represent operations that might be undertaken in a wireless receiver; however neither operation

corresponds to the scaling of an estimate of inter-symbol interference. Equation (41), on the other hand, does not represent actual operations that are performed in a receiver. Rather, Equation (41) represents part of a mathematical explanation as to why a particular interference suppression technique might be effective, given certain circumstances. *Id.* at p. 1539. Thus, Equation (41) illustrates the theoretical application of weights derived for a particular receiver configuration to a particular interference scenario. As Bottomley puts it, “the suppression of interference can be seen by applying the weights (scaling factor omitted) to the interference components of $y(mT_c)$.” Bottomley at p. 1541. Nothing in Bottomley suggests that a cancellation metric is being used to scale estimated inter-symbol interference. Rather, Equation (41) illustrates a mathematical model in which receiver combining weights are applied to interference components of a received signal. Read in context, it is clear that these interference components are mathematical models for components of interference to a CDMA signal, not estimates of those components. See Bottomley at pp. 1540-41. Bottomley does not teach the estimation of inter-symbol interference, and does not teach that an estimate of inter-symbol interference is scaled with a cancellation metric.

3. Neither reference discloses or suggests “estimating the received signal quality based on the scaled estimate of inter-symbol interference.”

Claim 1 recites, in part, “estimating the received signal quality based on the scaled estimate of inter-symbol interference.” The Final Office Action admits that this feature of the claims is not “explicitly” taught by either of the cited references, yet

asserts that Reznik “suggests” the recited feature. In fact, Reznik does not, and the examiner’s rejection is unsupported by the cited references.

a. Reznik does not teach or suggest estimating received signal quality at all.

Although the examiner admits that Reznik does not “explicitly” teach the estimation of received signal quality using a scaled estimate of inter-symbol interference, the Final Office Action asserts that this is “suggested” by Reznik, citing Reznik’s Figures 9-11, ¶¶ [0077] & [00101], and Equation (10). Final Office Action at pp. 6-7. This is simply false.

Reznik makes no mention at all of estimating receiver signal quality, and does not mention any commonly used measures of signal quality, such as signal-to-noise ratio (SNR), signal-to-interference ratio (SIR), or the like. Indeed, the examiner appears to be aware of this, as the Final Office Action makes no attempt to identify any references to signal quality in Reznik. Instead, the Final Office Action makes a vague reference to Reznik’s “soft-decision” and “hard-decision,” followed by an assertion that “one skilled in the art would know that these decisions may be used to compute the signal quality.” Final Office Action at pp. 6-7. As a statement of fact, this latter assertion is simply incorrect, and is unsupported by the teachings of either reference. In any event, Reznik provides no hint whatsoever that a scaled estimate of inter-symbol interference should be used to estimate received signal quality, and the examiner’s finding that Reznik somehow “suggests” this feature is factually and legally without basis.

b. Bottomley does not support a conclusion that Reznik’s hard decisions or soft decisions may be used to compute signal quality. As noted above, the Final Office Action alleges that a person of ordinary skill in the art would know that Reznik’s “soft

decisions” and “hard decisions” may be used to compute signal quality. For support, the examiner appears to quote Bottomley as saying “SNR is based on the decision statistic z .” Final Office Action at p. 6. In fact, Bottomley says nothing of the sort, and provides no support for the examiner’s contention. Bottomley actually says: “Given a specific weight vector \mathbf{w} , the symbol SNR ratio at the output of the combiner (the decision statistic z) can easily be shown to be $SNR = \frac{\mathbf{w}^H \mathbf{h} \mathbf{h}^H \mathbf{w}}{\mathbf{w}^H \mathbf{R}_u \mathbf{w}}$.” Bottomley at p. 1541.

Rather than teaching that a signal-to-noise ratio (SNR) may be calculated from decision statistics, Bottomley instead teaches how to calculate a signal-to-noise ratio that is referenced to the particular point in the radio receiver where the decision statistics are formed (i.e., at the output of the combiner). Indeed, Bottomley further provides details of the specific calculation, which is not in fact based on the decision statistic z at all. Rather, Bottomley’s SNR is based on receiver combining weights \mathbf{w} , channel coefficients \mathbf{h} , and a noise covariance matrix \mathbf{R}_u . See Bottomley at pp. 1539-1541. The examiner misquotes Bottomley, and the reference to Bottomley in support of the contention that Reznik somehow “suggests” estimating received signal quality based on a scaled estimate of inter-symbol interference is completely without merit.

B. The examiner fails to articulate reasoning with rational underpinning to support the legal conclusion of obviousness of claims 1, 17, and 31.

Even if the numerous deficiencies in the examiner’s factual findings are ignored, the rejection still fails to establish a prima facie case of obviousness because the examiner does not show that a person of ordinary skill in the art would find it obvious to

combine the alleged teachings of the references to yield the presently claimed invention. Indeed, these alleged teachings cannot in fact be combined to yield the claimed invention.

According to the Final Office Action, Bottomley teaches scaling estimated inter-symbol interference by a cancellation metric, but does not teach the particular cancellation metric of the present claims. Final Office Action at p. 5. The Final Office Action further alleges that Reznik teaches the claimed cancellation metric, proffering Reznik's "matrix S." *Id.* at pp. 5-6. The Final Office Action then concludes that "it would have been obvious (obvious to try) to one of ordinary skills in the art to have incorporated this feature in the system of Bottomley, in the manner as claimed and as taught by Reznik, for the benefit of suppressing inter-symbol interference at the receiver using a scalar value." *Id.* at p. 6.

According to the Supreme Court: "When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under §103." *KSR* at 1742. Here, the examiner has not suggested that the teachings of Reznik provide one or more of "a finite number of identified, predictable solutions." Further, the examiner has not provided any indication of precisely how Reznik's matrix S can be incorporated into the system of Bottomley, and has provided only a conclusory allegation that doing so would have a benefit.

In particular, Appellant note that the examiner appears to allege that Bottomley's $y_{ISI}(t)$ (as referenced in Bottomley's Equations (16), (18), and (20)) corresponds to the claimed "estimate of inter-symbol interference". See Final Office Action at p. 5. Accordingly, the examiner's rejection apparently concludes that it "would have been obvious to try" scaling Bottomley's y_{ISI} with Reznik's matrix S . However, the examiner does not explain what the result of this scaling would be, or why this would be successful. Neither Bottomley nor Reznik provides any hint of what the results of this operation would be, or why it should be attempted. Indeed, as shown above, Reznik teaches that matrix S may be used in an iterative cancellation loop, and specifically that it should be multiplied by a difference vector formed from subtracting a residual interference vector $\bar{c}(m)$ from a received signal vector \bar{y} . See Reznik ¶ [0075]. The examiner's rejection, however, appears to propose that Reznik's matrix S should be multiplied by Bottomley's $y_{ISI}(t)$, which comprises one of several theoretical components of the sampled output of a matched filter. See Bottomley at p. 1539 (particularly Eq. (20)). Appellant is at a loss to know what the result of applying Reznik's matrix S to a completely different quantity would represent, and neither reference provides any suggestion of how this result might subsequently be used to determine a received signal quality for a received signal in Bottomley's system.

Similarly, after acknowledging that neither reference teaches estimating received signal quality based on a scaled estimate of inter-symbol interference, the Final Office alleges that Reznik "suggests" doing so, and asserts that "it would have been obvious (obvious to try) to one of ordinary skill in the art to incorporate this feature into the

system of Bottomley, as modified by Reznik, in the manner as claimed...” Final Office Action at pp. 6-7. Again, the examiner supports the legal conclusion of obviousness with a mere conclusory statement (an identical conclusory statement, at that). Again, the examiner is merely splicing together unconnected snippets of the cited references and simply asserting that it would be obvious to combine them.

When examined closely, the rejection appears to suggest that Bottomley's signal-to-noise ratio calculation could be modified, using the teachings of Reznik, to yield the claimed invention. However, the present claims actually recite “estimating the received signal quality based on the scaled estimate of inter-symbol interference.” As noted above, the rejection appears to propose that the scaled estimate of inter-symbol interference might be formed by multiplying Bottomley's $y_{ISI}(t)$ by Reznik's matrix S . So, it might be expected that the estimation of received signal quality resulting from the combination of Bottomley should involve Bottomley's $y_{ISI}(t)$, as modified by Reznik's matrix S . On the other hand, the rejection specifically states that “one skilled in the art would know that [Reznik's hard and soft decisions] may be used to compute the signal quality.” Final Office Action at p. 6. The rejection further implies that Bottomley's decision statistic z is somehow connected to this calculation of signal quality. *Id.* However, Bottomley's calculation of signal-to-noise ratio (at Equation (43)) is based on neither $y_{ISI}(t)$ (the alleged estimate of inter-symbol interference) nor Bottomley's decision statistic z . Again, the Appellant is at a loss to understand precisely how Bottomley should be modified, using the teachings of Reznik, to yield the claimed invention. Again, the cited references (and the Final Office Action) are utterly devoid of

any suggestion that such a modification would be successful, or even that such a modification is possible. And again, the examiner's conclusion of obviousness is utterly unsupported by any articulated reasoning with a rational underpinning.

C. The rejections of at least dependent claims 3-6, 8, 11-13, 16, 19-21, 23, 26, 27, 33-35, 37, 40, 41, 43, 46 and 47 are unsupported by the references and legally improper.

The rejections of at least dependent claims 3-16, 19-30, and 33-47 are each based on either vague and unsupported citations to the references, unsupported allegations that “one skilled in the art would know” of the claimed feature, or both. These rejections fail utterly to establish a prima facie case of obviousness for the corresponding dependent claims, and these rejections are thus improper for at least these additional reasons.

1. Claims 3, 19, 33, and 43 are not rendered obvious by the cited references.

Claim 3 recites, in part, “transmitting corresponding channel quality information to a supporting wireless communication network.” Claims 19, 33, and 43 have corresponding limitations. The examiner first alleges that the combination of Bottomley and Reznik discloses the claimed feature, but then asserts: “Furthermore, one skilled in the art would know that WCDMA require mobile terminals to compute received signal quality and transmit TCP commands back to the Base station.” Final Office Action at p. 7. In fact, neither Bottomley nor Reznik make any mention of transmitting channel

quality information (or any other information) to a supporting wireless communication network, and the examiner's further allegations are without support in the record.

2. Claims 4, 20, and 34 are not rendered obvious by the cited references.

Claim 4 recites, in part, "generating corresponding link power control commands, and transmitting the link power control commands to a supporting wireless communication network." Claims 20 and 34 have corresponding limitations. The examiner's rejections of these claims are identical to those of claims 3, 19, and 33, and are similarly unsupported by the cited references.

3. Claims 5, 21, and 35 are not rendered obvious by the cited references.

Claim 5 recites, in part, "storing the cancellation metric in a memory of the receiver as a pre-configured value." Claims 21 and 35 have corresponding limitations. The examiner acknowledges that the claimed feature is not disclosed by the cited references, but then asserts that Reznik "suggests" the claimed feature. The examiner further asserts that "one skilled in the art would know that Matrix S is pre-computed prior to cancelling the inter-symbol interference. In fact, Reznik makes no mention or hint at "pre-configured values" of any sort, and makes no mention of storing any metrics in a memory. Further, the examiner's allegations as to what "one skilled in the art would know" are beside the point. Of course Reznik's matrix S is computed before it is subsequently used. This fact does not make Reznik's matrix S a pre-configured value, stored in memory of the receiver. Indeed, Reznik teaches that matrix S is calculated during the interference cancellation operation, as a function of matrix A, which is derived

from the instantaneous channel response. See Reznik ¶¶ [0029]-[0036]. This dynamically calculated matrix is precisely the opposite of a pre-configured value stored in memory.

4. Claim 6 is not rendered obvious by the cited references.

Claim 6 depends on claim 5 and recites, in part, “determining the pre-configured value of the cancellation metric by characterizing inter-symbol interference cancellation performance of the receiver, or of a same type of receiver.” The examiner alleges that the claimed feature is disclosed by the cited references. Final Office Action at p. 6. In addition to the fact that this finding contradicts the examiner’s finding with regards to claim 5 (i.e., that the pre-configured value is not disclosed, but merely “suggested” by Reznik), neither reference in fact makes any mention of characterizing the inter-symbol interference cancellation performance of a receiver.

5. Claims 8, 23, and 37 are not rendered obvious by the cited references.

Claim 8 recites, in part, “generating a corresponding transmit power control command, and transmitting the power control command to a supporting WCDMA network.” Claims 23 and 37 have corresponding limitations. The examiner’s rejection is essentially identical to those for claims 3 and 4, and is improper for exactly the same reasons.

6. Claims 11, 26, 40 and 46 are not rendered obvious by the cited references.

Claim 11 includes an extensive recitation of details for estimating received signal quality, and recites, in part, “estimating a received signal power for the received signal.” Claims 26, 40, and 46 include corresponding limitations. The examiner cites Bottomley for these elements. Final Office Action at p. 10. In fact, Bottomley is utterly silent with respect to estimating a received signal power for the received signal, and in no event teaches the detailed calculation recited in claims 11, 26, 40, and 46.

7. Claims 12, 27, 41, and 47 are not rendered obvious by the cited references.

Claim 12 depends on claim 11, and recites, in part, that “the received signal power ... is estimated using combined values corresponding to RAKE fingers in the receiver.” Claims 27, 41, and 47 have corresponding limitations. The examiner’s rejection is essentially identical to that of claim 11, and is improper for the same reason given above, i.e., that Bottomley makes no mention of estimating received signal power.

8. Claim 13 is not rendered obvious by the cited references.

Claim 13 depends on claim 11, and recites, in part, that “calculating the received signal power based on the magnitudes of net channel responses and signal amplitudes for propagation paths associated with the received signal.” The examiner’s rejection is identical to those for claims 12 and 13, and is improper for at least the same reason given above.

9. Claim 16 is not rendered obvious by the cited references.

Claim 16 recites, in part, “generating a combined estimate for inter-symbol interference and other impairment in the received signal and removing a noise variance estimate corresponding to the other impairment from the combined estimate to obtain the cancellation metric.” The examiner provides a vague citation to Bottomley in support of the rejection. Final Office Action at page 12. In fact, Bottomley does not disclose or suggest any procedure in which a combined estimate is first formed and then a noise variance estimate removed from the combined estimate to obtain a cancellation metric. The Appellant can discern no factual basis for the examiner’s citation to Bottomley whatsoever, and the rejection is improper for at least this additional reason.

(VIII.) CLAIMS APPENDIX

The following claims are on appeal:

1. A method of determining received signal quality for a received signal in an inter-symbol interference canceling receiver comprising:

generating an estimate of inter-symbol interference in the received signal;

scaling the estimated inter-symbol interference by a cancellation metric

comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver; and

estimating the received signal quality based on the scaled estimate of inter-symbol interference.

2. The method of claim 1, wherein estimating the received signal quality based on the scaled estimate of inter-symbol interference comprises estimating a signal-to-interference ratio of the received signal.

3. The method of claim 2, further comprising periodically estimating the signal-to-interference ratio of the received signal and periodically transmitting corresponding channel quality information to a supporting wireless communication network.

4. The method of claim 2, further comprising periodically estimating the signal-to-interference ratio of the received signal, generating corresponding link power control commands, and transmitting the link power control commands to a supporting wireless communication network.

5. The method of claim 1, further comprising storing the cancellation metric in a memory of the receiver as a pre-configured value.
6. The method of claim 5, further comprising determining the pre-configured value of the cancellation metric by characterizing inter-symbol interference cancellation performance of the receiver, or of a same type of receiver.
7. The method of claim 1, further comprising maintaining the cancellation metric as a dynamically updated value based on inter-symbol interference cancellation performance of the receiver as measured during operation.
8. The method of claim 1, wherein the received signal comprises a WCDMA Dedicated Physical Channel (DPCH) signal, and wherein determining received signal quality for a received signal in an inter-symbol interference canceling receiver comprises, for each timeslot of the DPCH signal, estimating the received signal quality based on the scaled estimate of inter-symbol interference, generating a corresponding transmit power control command, and transmitting the power control command to a supporting WCDMA network.
9. The method of claim 1, wherein generating an estimate of inter-symbol interference in the received signal comprises generating an expected value of the inter-symbol interference in the received signal.

11. The method of claim 1, wherein estimating the received signal quality based on the scaled estimate of inter-symbol interference comprises estimating a received signal power for the received signal, estimating an additional impairment component of the received signal corresponding to other than inter-symbol interference, and calculating the signal-to-interference ratio of the received signal as a ratio of the received signal power over a sum of the scaled estimate of inter-symbol interference and the additional impairment component.

12. The method of claim 11, wherein the received signal power, the scaled estimate of inter-symbol interference, and the additional impairment component, are estimated using combined values corresponding to RAKE fingers in the receiver that are associated with the received signal.

13. The method of claim 11, wherein estimating a received signal power for the received signal comprises calculating the received signal power based on the magnitudes of net channel responses and signal amplitudes for propagation paths associated with the received signal.

14. The method of claim 11, wherein estimating an additional impairment component of the received signal corresponding to other than inter-symbol interference comprises estimating an interference variance based on received pilot channel symbols.

15. The method of claim 1, further comprising storing a cancellation metric for each of one or more supporting network transmitters, and wherein scaling the estimated inter-symbol interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver comprises scaling an estimated inter-symbol interference estimate for each of the one or more network transmitters by the corresponding cancellation metric.

16. The method of claim 1, further comprising determining the cancellation metric based on generating a combined estimate for inter-symbol interference and other impairment in the received signal and removing a noise variance estimate corresponding to the other impairment from the combined estimate to obtain the cancellation metric.

17. A processing circuit configured for use in an inter-symbol interference canceling receiver, the processing circuit comprising:

an interference estimation circuit configured to generate an estimate of inter-symbol interference in the received signal;

a scaling circuit included in, or associated with, the interference estimation circuit and configured to scale the estimated inter-symbol interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver; and

a signal quality estimation circuit configured to estimate the received signal quality based on the scaled estimate of inter-symbol interference.

18. The processing circuit of claim 17, wherein the processing circuit is configured to estimate the received signal quality based on the scaled estimate of inter-symbol interference by estimating a signal-to-interference ratio of the received signal.

19. The processing circuit of claim 18, wherein the processing circuit is configured to periodically estimate the signal-to-interference ratio of the received signal for periodic transmission of corresponding channel quality information to a supporting wireless communication network.

20. The processing circuit of claim 18, wherein the processing circuit is configured to periodically estimate the signal-to-interference ratio of the received signal and generate corresponding link power control commands for transmission to a supporting wireless communication network.

21. The processing circuit of claim 17, wherein the processing circuit is configured to receive a pre-configured value from a memory in the receiver as the cancellation metric.

22. The processing circuit of claim 17, wherein the processing circuit is configured to maintain the cancellation metric as a dynamically updated value based on inter-symbol interference cancellation performance of the receiver as measured during operation.

23. The processing circuit of claim 17, wherein the received signal comprises a WCDMA Dedicated Physical Channel (DPCH) signal, and wherein the processing circuit is configured to determine received signal quality for the DPCH signal by, for each timeslot of the DPCH signal, estimating the received signal quality based on the scaled estimate of inter-symbol interference and generating a corresponding transmit power control command for transmission to a supporting WCDMA network.

24. The processing circuit of claim 17, wherein the processing circuit is configured to generate an estimate of inter-symbol interference in the received signal by generating an expected value of the inter-symbol interference in the received signal.

26. The processing circuit of claim 17, wherein the processing circuit is configured to estimate the received signal quality based on the scaled estimate of inter-symbol interference by estimating a received signal power for the received signal, estimating an additional impairment component of the received signal corresponding to other than inter-symbol interference, and calculating the signal-to-interference ratio of the received signal as a ratio of the received signal power over a sum of the scaled estimate of inter-symbol interference and the additional impairment component.

27. The processing circuit of claim 26, wherein the processing circuit is configured to estimate the received signal power, the scaled estimate of inter-symbol interference, and the additional impairment component, based on combined values corresponding to RAKE fingers in the receiver that are associated with the received signal.

28. The processing circuit of claim 17, wherein the processing circuit comprises at least a portion of an integrated circuit device that is arranged and configured for baseband signal processing in a wireless communication receiver.

29. The processing circuit of claim 17, wherein the processing circuit is configured to use a cancellation metric for each of one or more supporting network transmitters, and wherein the scaling circuit is configured to scale an inter-symbol interference estimate for each transmitter using the corresponding cancellation metric.

30. The processing circuit of claim 29, wherein the one or more supporting network transmitters are associated with different network cells, and wherein the processing circuit estimates and scales inter-symbol interference on a per cell basis.

31. A wireless communication device for use in a wireless communication network comprising:

a receiver configured to receive signals from the network;

a transmitter configured to transmit signals to the network;

one or more control circuits configured to control operation of the receiver and transmitter; and

said receiver comprising one or processing circuits comprising:

an interference estimation circuit configured to generate an estimate of inter-symbol interference in the received signal;

a scaling circuit included in, or associated with, the interference estimation circuit and configured to scale the estimated inter-symbol interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver; and

a signal quality estimation circuit configured to estimate the received signal quality based on the scaled estimate of inter-symbol interference.

32. The device of claim 31, wherein the processing circuit is configured to estimate the received signal quality based on the scaled estimate of inter-symbol interference by estimating a signal-to-interference ratio of the received signal.

33. The device of claim 32, wherein the processing circuit is configured to periodically estimate the signal-to-interference ratio of the received signal and wherein the device is configured to periodically transmit corresponding channel quality information to a supporting wireless communication network.

34. The device of claim 32, wherein the processing circuit is configured to periodically estimate the signal-to-interference ratio of the received signal and generate corresponding link power control commands, and wherein the device is configured to transmit the link power control commands to a supporting wireless communication network.

35. The device of claim 31, wherein the processing circuit is configured to receive a pre-configured value from a memory in the device as the cancellation metric.

36. The device of claim 31, wherein the processing circuit is configured to maintain the cancellation metric as a dynamically updated value based on inter-symbol interference cancellation performance of the receiver as measured during operation.

37. The device of claim 31, wherein the received signal comprises a WCDMA Dedicated Physical Channel (DPCH) signal, and wherein the processing circuit is configured to determine received signal quality for the DPCH signal by, for each timeslot of the DPCH signal, estimating the received signal quality based on the scaled estimate of inter-symbol interference and generating a corresponding transmit power control command for transmission by the device to a supporting WCDMA network.

38. The device of claim 31, wherein the processing circuit is configured to generate an estimate of inter-symbol interference in the received signal by generating an expected value of the inter-symbol interference in the received signal.

40. The device of claim 31, wherein the processing circuit is configured to estimate the received signal quality based on the scaled estimate of inter-symbol interference by estimating a received signal power for the received signal, estimating an additional impairment component of the received signal corresponding to other than inter-symbol interference, and calculating the signal-to-interference ratio of the received signal as a ratio of the received signal power over a sum of the scaled estimate of inter-symbol interference and the additional impairment component.

41. The device of claim 40, wherein the processing circuit is configured to estimate the received signal power, the scaled estimate of inter-symbol interference, and the additional impairment component, based on combined values corresponding to RAKE fingers in the receiver that are associated with the received signal.

42. The device of claim 31, wherein the device comprises a mobile terminal configured for operation in a WCDMA wireless communication network, and wherein the device is configured to determine the received signal quality via use of the processing circuit for one or more received WCDMA signal transmitted by the network.

43. The device of claim 42, wherein the mobile terminal is configured periodically to report Channel Quality Information for a High Speed Packet Data Service signal transmitted by the network based on determining received signal quality for the signal via the processing circuit.

44. The device of claim 42, wherein the mobile terminal is configured periodically to transmit forward link power control commands to the network based on determining received signal quality via the processing circuit for one or more WCDMA signals transmitted by the network.

45. A computer readable medium storing a computer program to determine received signal quality for a received signal in an inter-symbol interference canceling receiver, the computer program comprising:

program instructions to generate an estimate of inter-symbol interference in the received signal;

program instructions to scale the estimated inter-symbol interference by a cancellation metric comprising a scalar value representing characterized or measured inter-symbol interference cancellation performance of the receiver; and

program instructions to estimate the received signal quality based on the scaled estimate of inter-symbol interference.

46. The computer readable medium of claim 45, wherein the program instructions to estimate the received signal quality based on the scaled estimate of inter-symbol interference comprise program instructions to estimate a received signal power for the received signal, estimate an additional impairment component of the received signal corresponding to other than inter-symbol interference, and calculate the signal-to-interference ratio of the received signal as a ratio of the received signal power over a sum of the scaled estimate of inter-symbol interference and the additional impairment component.

47. The computer readable medium of claim 46, wherein the received signal power, the scaled estimate of inter-symbol interference, and the additional impairment component, are estimated using combined values corresponding to RAKE fingers in the receiver that are associated with the received signal.

(IX.) EVIDENCE APPENDIX

No evidence was submitted by Appellant pursuant to 37 CFR §§ 1.130, 1.131, or 1.132, and no other evidence was entered by the examiner and relied upon by appellant in this appeal.

(X.) RELATED PROCEEDINGS APPENDIX

No related proceedings have been identified.

Respectfully submitted,

COATS & BENNETT, P.L.L.C.

A handwritten signature in black ink, appearing to read 'D.P. Homiller', written over a horizontal line.

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